An illustration of the practical use in aviation of operational real-time geostationary satellite data

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operational use of real-time geostationary satellite data for tactical and strategic flight planning

improving flight safety

improving flight comfort

reduce fuel use ($) 

reduce delays ($)
Outline

- how it started: IAGOS
- near-real-time geostationary precipitation measurements (CPP)
- examples of intercontinental flight paths & maneuvers
- business case
- summary & what’s next
IAGOS
(In service Aircraft for a Global Observing System)
formerly known as MOZAIC

- small number of commercial airlines (5-10) equipped with a small sensor package to measure atmospheric parameters and air pollution

- Operational since 1994

- Large flight database covering all continents (including Africa)

- **Can be used to compare routes against Geostationary Weather Satellite data → IAGOS measurements of High Ice Water Content**

18 MOZAIC/IAGOS flights in 2008 for first time ever such an analysis was made
• KNMI Cloud Physical Parameter algorithm (CPP)

• cloud top height
• precipitation rate
• and a few more ...

• geostationary = fixed point in space (always the same part of the globe)
• daytime, every 15 minutes (but we do have nighttime precip as well ...)
• SEVIRI (EUMETSAT’s METEOSAT 10)
• **data publicly available with 30-45 minutes latency**
• spatial resolution 3x3 km sub-satellite to 10x10 km at the edge of view
flight 24 March 2008

Frankfurt – Windhoek

Colors – cloud top height

Only part of SEVIRI disc
evasive maneuver

± 0.5° from position
(± 50 km or ± 27 nm)

Indication of on-board radar view

white part of track
± 7.5 minutes from CPP
(CPP every 15 minutes)
Can be used to compare routes against Geostationary Weather Satellite data → IAGOS measurements of High Ice Water Content?

Not really, aircraft most of the time avoid the clouds we were interested in

(bummer!)

→ avoiding certain cloud systems according to satellite data = satellite data useful for tactical/strategic flight planning?
- Mesoscale Convective System
- pseudo-radar suggests no alternative route to be seen with on-board radar
- Penetrate thunderstorm
- Apparently pilot finds corridor in precipitation ➔ on-board radar
However, with CPP half hour before (14:15) a clear alternative path is visible which is still present half an hour later (14:45)
IAGOS flight 7 August 2008

- Penetrating three (3) Mesoscale Convective Systems within 2 hours
- No apparent attempts to change route
CPP pseudo radar suggests no alternative routes visible with on-board radar (possible exception MCS 3)
CPP pseudo radar & precipitation suggests nevertheless clearly indicate alternative routes.
Why do aircraft sometimes avoid cloud systems, but not always?

**guidelines**

- Avoid thunderstorms if possible
- Possible = given available information (on-board radar, visible)
- Try to stay 20 NM away from heavy-extreme precipitation radar signals
- In case of penetrating a thunderstorm, fly straight ahead and out of system ASAP

which in effect means:

- If radar shows a thunderstorm, find a path through or around them
- If radar shows no path through or around a thunderstorm, fly in and straight through

➔ on-board radar range is a limiting factor
➔ **satellite data does not have this “range” problem**
idea is not completely ‘new’

→ operational tests in the USA with USA ground weather radar network

• Operational decision chain run @ ground control
• Suggestion for alternative route sent to aircraft
• Crew decided whether to accept alternative route

result: average flight time of 6-8 minutes shorter $\approx$ **US $400 per flight**

37.4 million commercial flights globally in 2014 alone (approximately 100,000 flights per day)

assuming US $3,585/flight-hour operational costs for a B737 aircraft and 6 to 8 minutes shorter flights operational costs of commercial airlines are estimated between US $1000-$15000/flight-hour depending on aircraft size (the larger, the more expensive). Source: FAA
sort of a summary

Operational use geostationary near-real-time precipitation data

Geostationary = also when no ground weather radar is available

It works !!! → aircraft change routes consistent with satellite data

Geostationary operational precipitation data available (KNMI, but probably from other institutes and agencies as well)

Potential for global network (KNMI currently does SEVIRI = EU/AFR, but tested HIMAWARI = east ASIA/AUS → GOES-R/Americas launched 2016)

Implementation for tests should be simple & straight forward

Large potential:

- improving flight safety
- improving flight comfort
- reduced flight time
- reduced fuel use ($/€)
- reduced delays ($/€)
Final remark

(near-)real-time environmental information in the cockpit = future better be prepared.
Thank you

for supporting material available + more examples + papers/documents

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approach me during conference

6 to 10 November 2017, Météo-France, Toulouse
additional material